Restoration Research on Kelp Forest Habitat in the Salish Sea

Braeden Schiltroth, Sherryl Bisgrove, Bill Heath

Biological Sciences, Simon Fraser University, BC

Braeden Schiltroth
MSc. Candidate
bschiltr@sfu.ca
778-960-4002

Introduction/Background

- Kelp beds are marine sanctuaries, providing some of the most productive ecosystems on the planet and serving as critical habitat and refuge for many species[1].

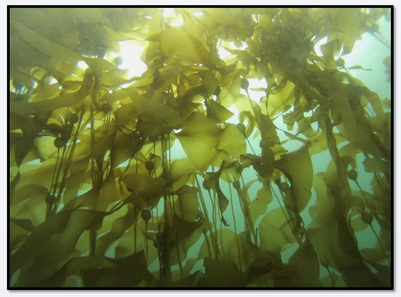

Fig 1. Kelp forest from a restoration site near Hornby Island. Photo courtesy of Bill Heath.

- The large, majestic algal species, *Nereocystis luetkeana*, dominates many kelp forests in coastal waters of southern B.C.
- However, losses of bull kelp have been reported from various community based-groups [2,3,4].
- Increases in stressors associated with climate change (eg. rising ocean temperatures) are thought to be a major contributor to kelp declines[5]. Thus, their survival will depend on the ability of existing populations to either withstand or adapt to these stressors.

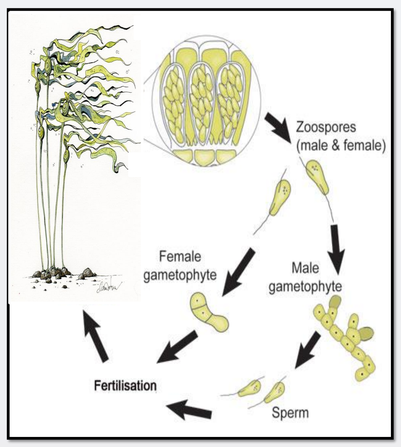

Fig 2. The annual life cycle of *Nereocystis*

- *Nereocystis* has an annual life cycle, potentially making it more susceptible to rapid changes in ocean conditions.
- This problem could be mitigated by planting individuals from neighbouring populations that are better adapted for growth in warmer waters.
- The goal of this research is to assess the tolerance of different populations of bull kelp to thermal stress.
- These studies will provide crucial data needed for habitat restoration efforts as they will allow for the selection of stress-resilient kelp stocks that are better adapted for survival in warmer oceans.

Methods

1) Collections at sites via canoe or snorkeling
2) Transport samples, prep them for spore release in lab
3) Evaluate spores as they develop under different temp treatments



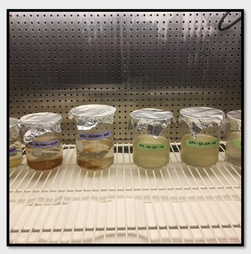

Fig 3. Collections, sori preparation, and spore release for experimental trials

Results

1) Evaluate whether *Nereocystis* in the Salish Sea is living in stressful conditions

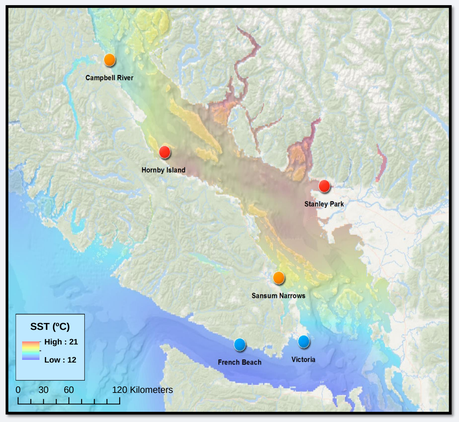

Fig 4. SST data from a hot summer day collected from NOAA's GHRSST. Shows hot, intermediate, and cold sites being monitored for SST. All sites had kelp present in 2016.

- Found largely variable sea surface temperatures (SST's) in the Central Strait of Georgia compared to the more southern Strait of Juan De Fuca[6].
- Throughout the summer, temperatures were about 6 ºC higher on average in the strait of Georgia.

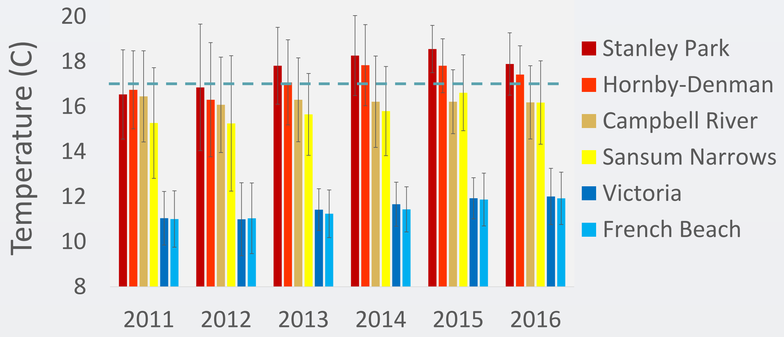

Fig 5. SST's compiled by NOAA's GHRSST. Show the SST averages for the summer months of June, July, and August over the past 6 years. Dashed line indicates the SST (17 ºC) where Nereocystis begins to experience harmful effects.

2) Establish protocols appropriate for measuring thermal tolerance in *Nereocystis*

- Sori formation
- Spore density
- Percent germination
- Percent lysed
- Gametophyte formation
- ROS levels

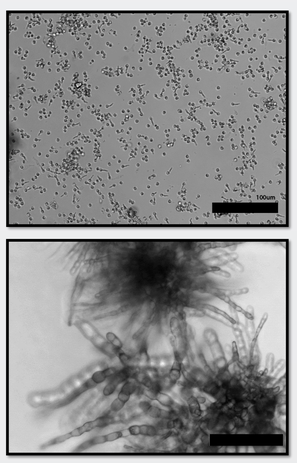

Fig 6. Spores germinating 24 hours after release (top). Male and female gametophytes after 2 weeks (bottom). Sizebar=100µm

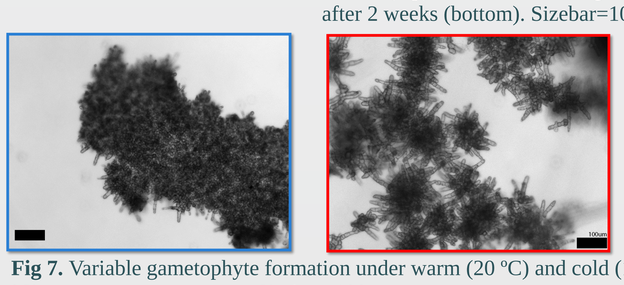

Fig 7. Variable gametophyte formation under warm (20 ºC) and cold (10 ºC) temperature treatments. Sizebar=100µm

Future Directions

3) Compare thermal tolerances of *Nereocystis* populations from different regions of the Salish Sea

- I will compare Stanley Park spores with those from French Beach, one of the cooler sites in the Salish Sea, as well as other local sites if time permits.
- Will find upper limits of tolerance at Stanley Park, create temperature response curve
- Will also compare levels of reactive oxygen species (ROS) between populations

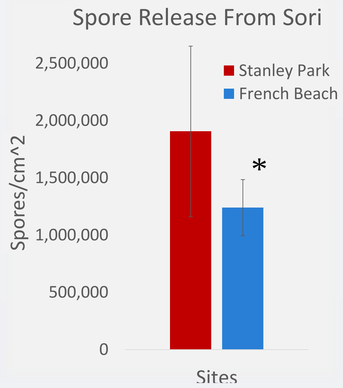

Fig 8. Spore densities were higher at Stanley Park than French Beach

Restoration Sites

- Restoration sites near Hornby Island, Comox
- Project Watershed, Nile Creek Enhancement Society, Hornby Island Diving
- Have shown significant progress, are forming reproductive sori

Fig 9. Lines of *Nereocystis* at the Maude Reef restoration site. Drone photos courtesy of Rob Zielinski

Conclusions

- We know there are regions in the Salish Sea with dramatically different temperature regimes during summer
- We know bull kelp in the Salish Sea is already living in conditions thought to be stressful
- More testing will show if populations that have developed in warm conditions will be more resilient to rising ocean temperatures

References

1. Mann, K. H. (1973). Seaweeds : Their Productivity and Strategy for Growth. *Their Productivity and Strategy for Growth*, *182*(4116), 975–981.
2. Help the Kelp. (2015) HelptheKelp. *http://helpthekelp.blogspot.ca/*
3. Nile Creek Enhancement Society (2016) Kelp Project. *http://nilecreek.org/kelp-habitat*
4. Puget Sound Restoration Fund. (2016) Kelp Restoration. *http://www.restorationfund.org/projects/kelp*
5. Fujita, R., Moxley, J. H., DeBey, H., Van Leuvan, T., Leumer, A., Honey, K., … Foley, M. (2013). Managing for a resilient ocean. *Marine Policy*, *38*, 538–544. http://doi.org/10.1016/j.marpol.2012.05.025
6. GHRSST. (2017). Multi-scale Ultra-high Resolution (MUR) SST Analysis fv04.1, Global, 0.01°, 2002-present, Daily. *http://coastwatch.pfeg.noaa.gov/erddap/griddap/jplMURSST41.html*

Acknowledgements

This project wouldn't be possible without help from: Dr. Sherryl Bisgrove, Dr. Bill Heath, Dr. Michael Hart, Pacific Salmon Foundation, Nile Creek Enhancement Society, Project Watershed, Hornby Island Diving, Amanda & Rob Zielinski, Tommy Hae-Ryoung Kim, and Mary Clinton